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(54) **Combined infra-red and visible spectrum television camera arrangement**

(57) The television camera has a first camera section 101 and a second camera section 102. A viewfinder 103 is arranged to receive video signals from said first camera section and said second camera section. The first camera section responds to conventional light sources and the second camera section responds to light substantially outside the visible spectrum, such as infra-red light. The resulting video signals may be selected or combined in order to facilitate new creative techniques. The sections operate in unison so that a substantially similar scene may be viewed as illuminated in response to visible light or as illuminated in response to non-visible light. In a studio ambient light is preferably excluded and the scene to be televised is illuminated with visible light sources and infra-red light sources. Each infra-red light source may include six modules, each module containing 100 light emitting diodes.

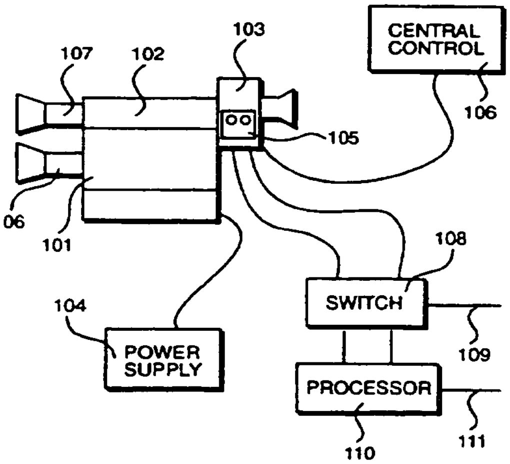

Figure 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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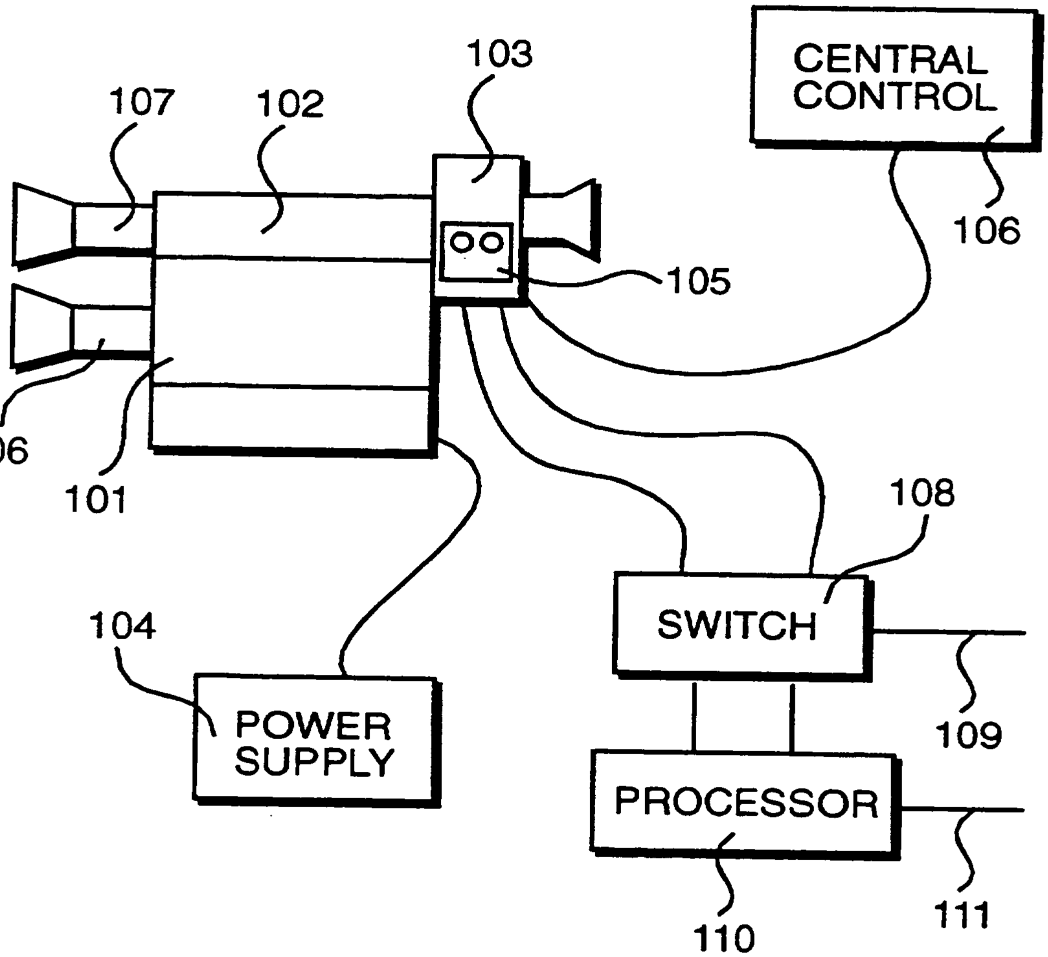
107
102
103
CENTRAL
CONTROL
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105
106
101
108
104
SWITCH
POWER
SUPPLY
109
PROCESSOR
110
111

Figure 1

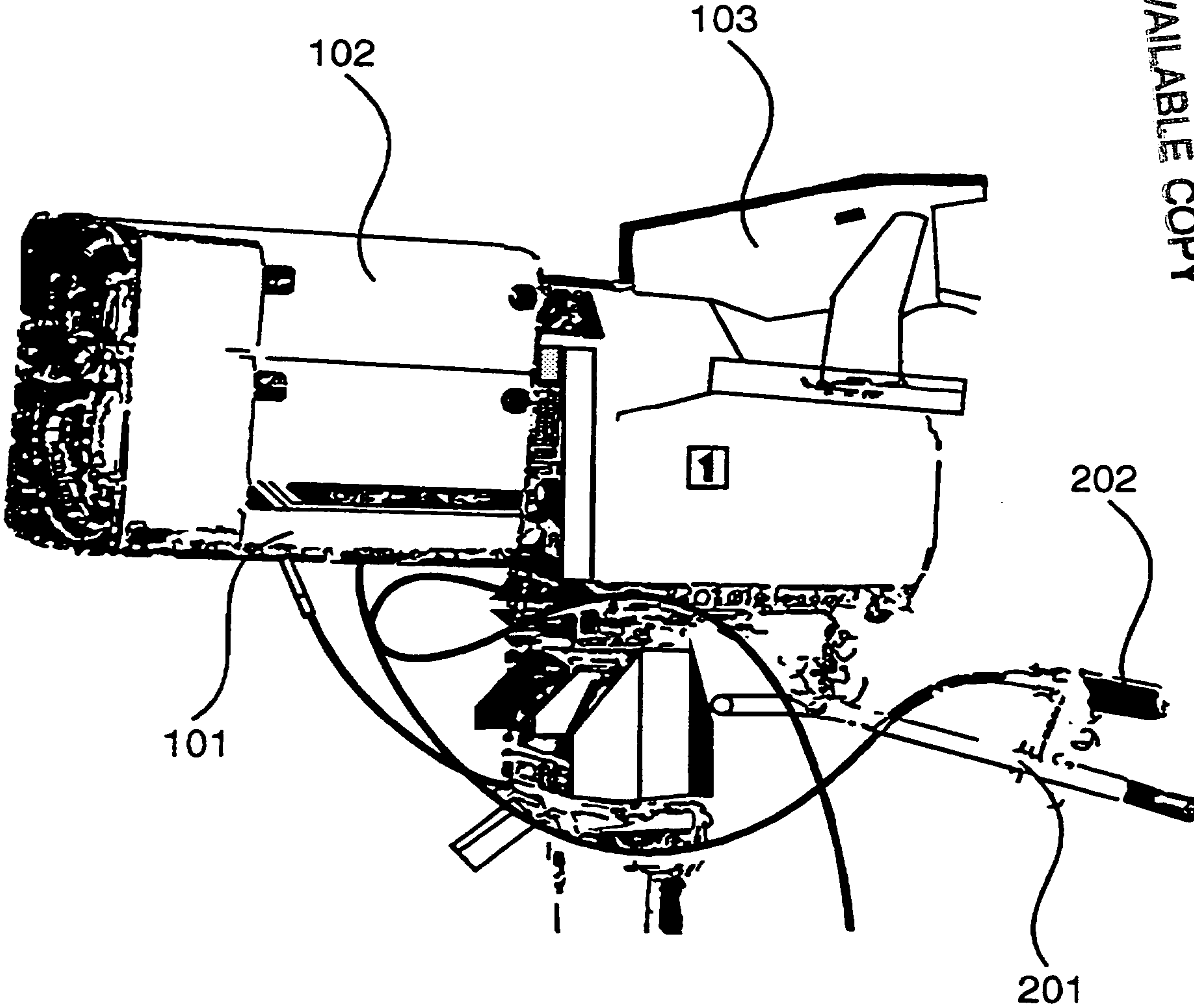

Figure 2

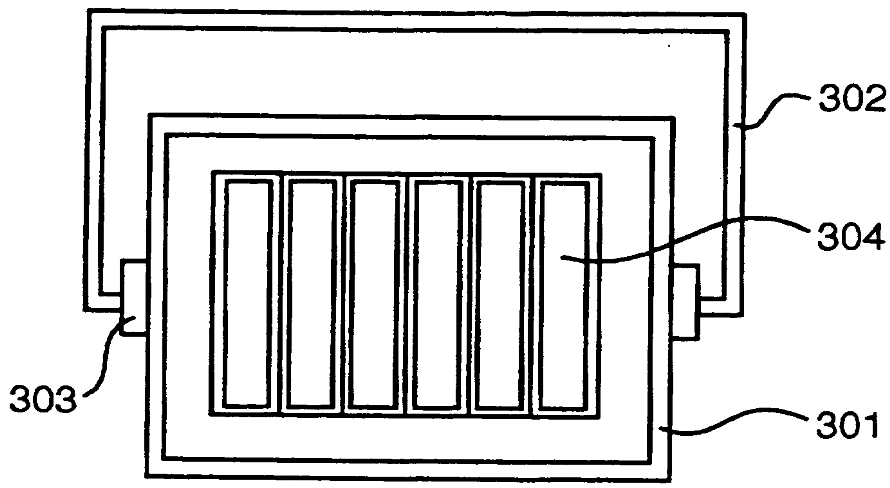

Figure 3

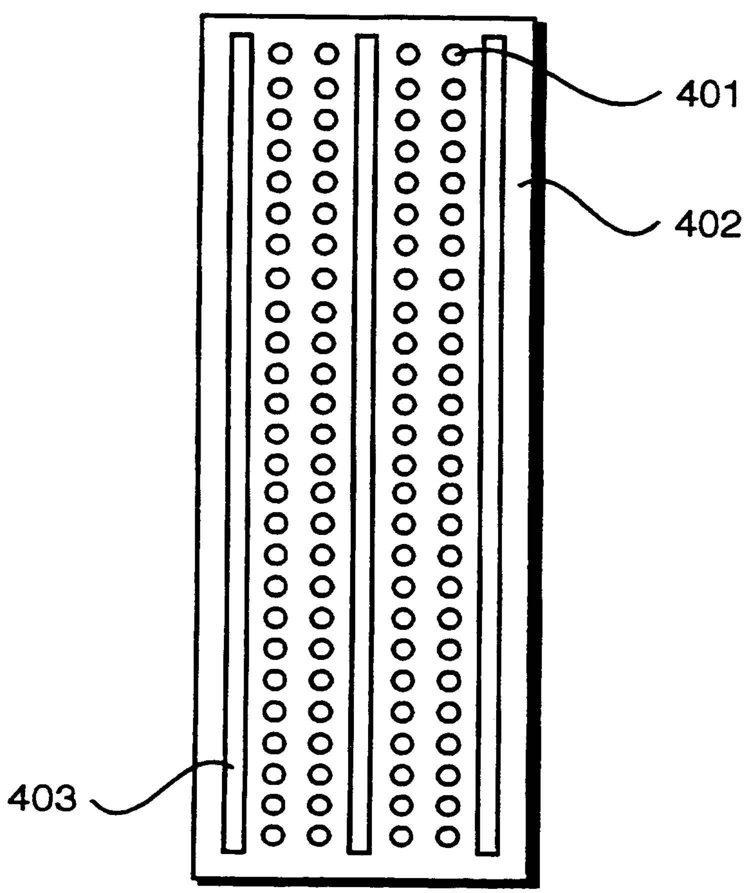

Figure 4

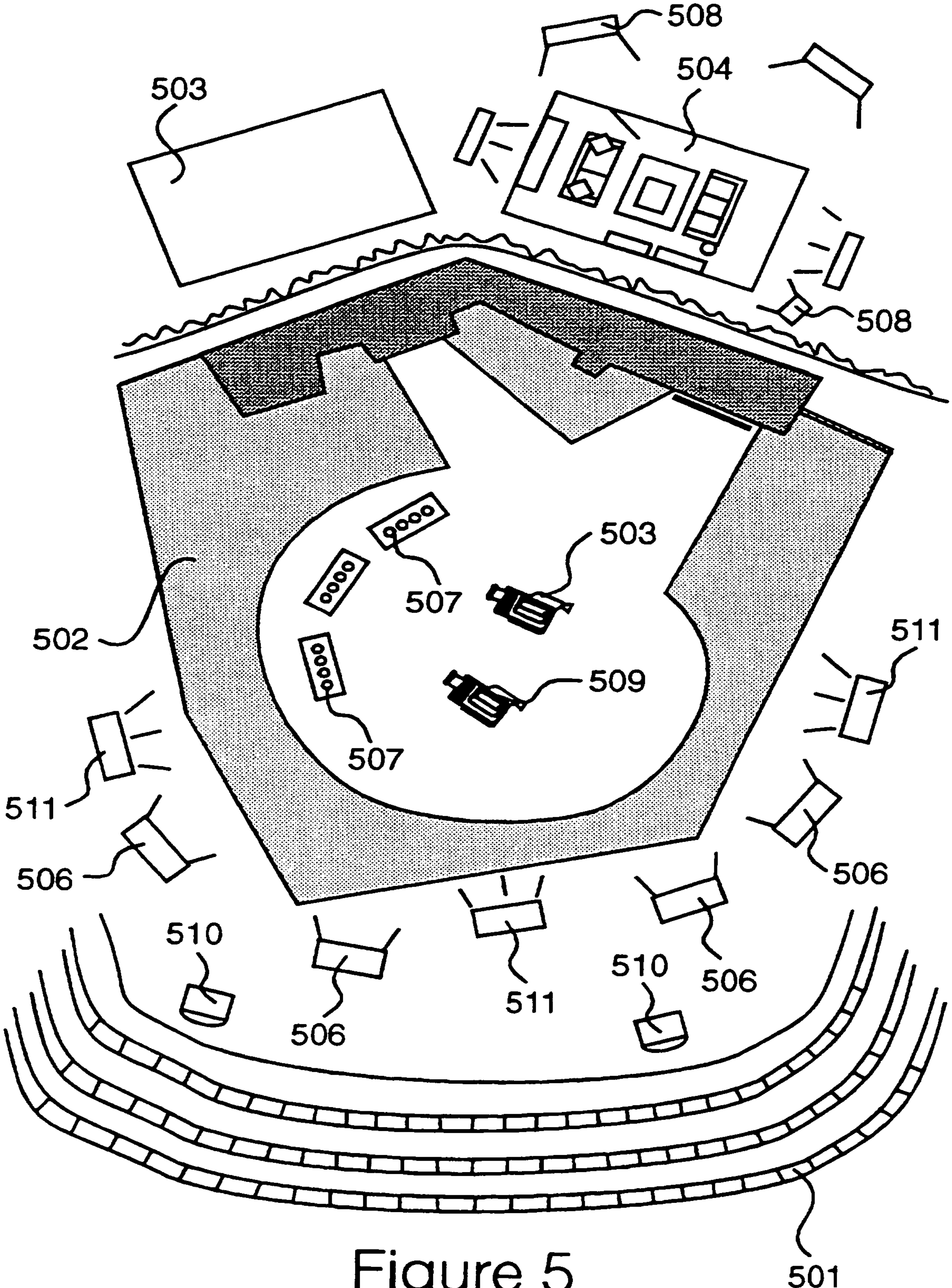
508
503
504
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Figure 5

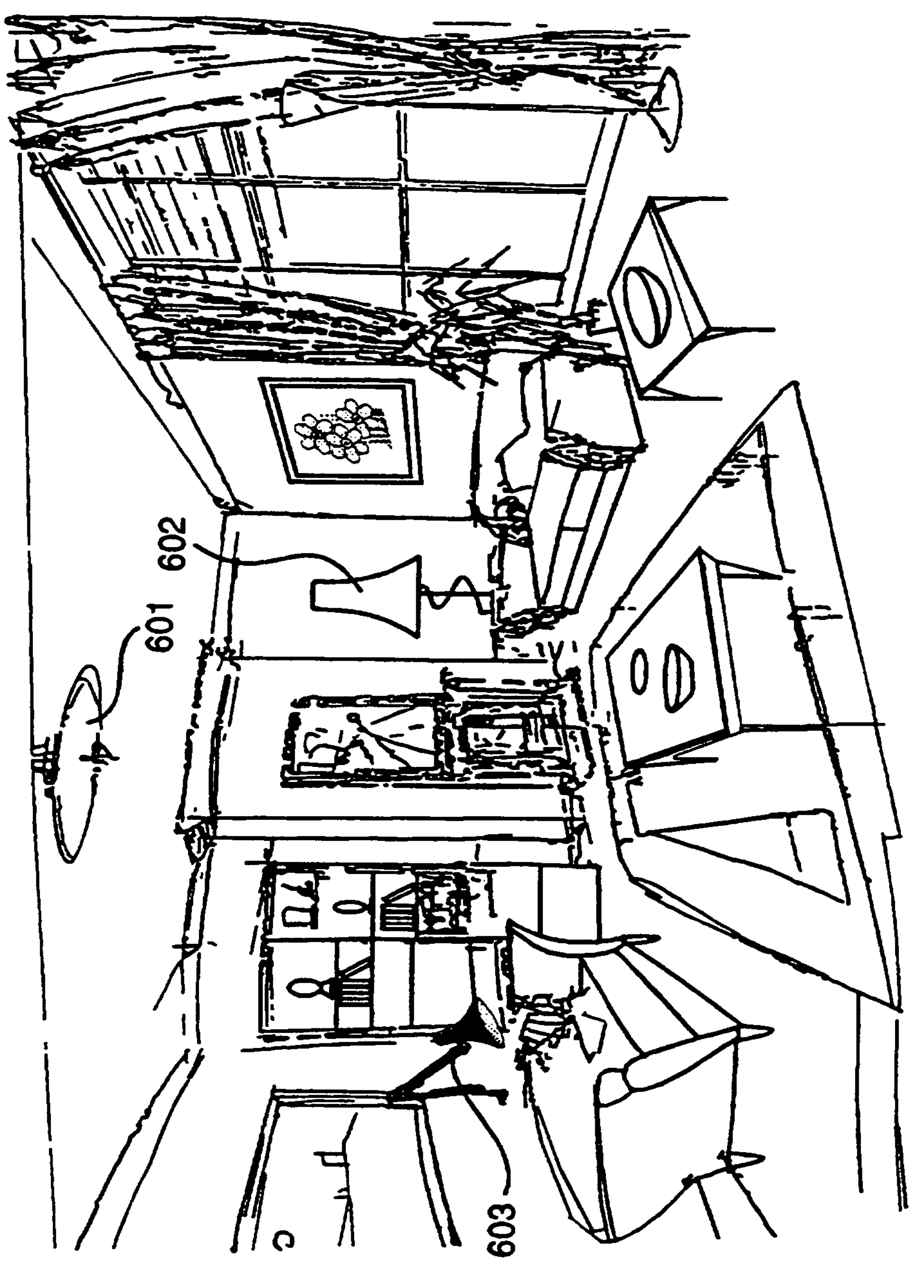

Figure 6

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PRODUCING TELEVISION SIGNALS

The present invention relates to television signal generating apparatus, a method of processing a plurality of video signals and a television production facility.

There are many types of different video cameras engineered for specific visual applications. The development of charged couple devices (CCD) as a mechanism for converting light energy into electrical energy has allowed cameras to be used in much more demanding environments, particularly when responding to relatively low levels or relatively high levels of light. Miniaturisation and the incorporation of recording mechanisms has also allowed video cameras to be used in outdoor, fast-moving or hostile environments where a traditional studio type camera would be unsuitable.

A television camera may be considered as a video camera suitable for generating television pictures, as distinct from other types of camera, such as low budget domestic cameras, surveillance cameras, inspection cameras, and so on where factors other than picture quality may take preference. In most countries a certain level of picture quality is now taken for granted, particularly given the ever-increasing quality of television receivers and video monitors.

Over recent years there have been many new developments in the field of image processing and special effects. Special effects may be

achieved by setting up particular conditions within a studio or outside broadcast environment, often using a plurality of cameras synchronized so that pictures may be combined from a plurality of sources to provide a composite image. Further special effects may be introduced after a television program has been produced and the introduction of new effects at this stage is often referred to as post-production. Recently, many advances have been made in terms of new post-production facilities. The problem with post-production techniques is that they cannot be used for live broadcasts such that, if these techniques are required, programs must be recorded and the recordings supplied to a post-production facility. Clearly, this adds to the cost of the overall production, in that the programs must be recorded in a suitable format and facility house charges must be met.

According a first aspect of the present invention, there is provided television signal generating apparatus, comprising a first camera section, a second camera section and a viewfinder arranged to receive video signals from said first camera section and from said second camera section, wherein said first camera section is configured to generate a video signal in response to incident light substantially within the human visible spectrum and said second camera section is configured to generate a video signal from incident light substantially outside said visible spectrum.

In a preferred embodiment, the first camera section and said viewfinder form part of a conventional broadcast quality camera and said second camera section is attached to said conventional camera.

Preferably, the second camera section is arranged to generate a video signal in response to infra-red light.

According to a second aspect for the present invention, there is provided a method of processing a plurality of video signals to produce an output video signal, wherein a first video signal is derived from a camera section responsive to light having a first range of frequencies and a second video signal is derived from a camera section responsive to a second range of frequencies, wherein said second range of frequencies is different from said first range.

In a preferred embodiment, video signals are selectable in response to manual operation.

According to a third aspect of the present invention, there is provided a television production facility, comprising means for excluding ambient light; a plurality of visible light sources for illuminating a scene with visible light; a plurality of infra-red light sources for illuminating a scene at infra-red frequencies; a first camera arranged to produce an image of said scene in response to visible light; and a second camera arranged to produce a substantially similar image in response to infra-red light.

An advantage of the present invention is that it allows a greater level of flexibility within the on-line studio environment. Firstly, video signals created from light sources outside the visible spectrum may be used for creative purposes and may allow new program formats to be

developed. Secondly, the video signal generated from light sources outside the visible spectrum may be used to perform technical processes, such as keying, upon the visible spectrum signals. Thirdly, the additional video signal may be used to provide subtle enhancements to traditional signals. Thus, the on-line combination of video signals derived from different lighting sources provides a new tool for use within television production environments.

The invention will now be described by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic representation of a first camera section used in combination with a second camera section;

Figure 2 details a camera having two sections, of the type identified in Figure 1, arranged to receive non-visible light from scenes illuminated by appropriate light sources;

Figure 3 illustrates a light source for generating light outside the visible spectrum, for use in combination with the camera shown in Figure 2 and including an array of light emitting devices;

Figure 4 details an array of light emitting devices of the type shown in figure 3;

Figure 5 illustrates a television studio including cameras of the type shown in Figure 2 and a plurality of light sources of the type shown in figure 3, including a plurality of sets; and

Figure 6 details a typical set of the type shown in Figure 5.

A television camera is shown in Figure 1 having a first camera section 101 and a second camera section 102, each arranged to selectively supply video signals to a viewfinder 103. Each video section receives power from a power supply unit 104 and the camera sections 101 and 102 are responsive to manual control via controls 105. In addition, the cameras are adjustable in response to control signals from a central control unit 106.

The first camera section 101 produces conventional broadcast quality video signals in response to light received via a lens system 106. The second camera section produces a video signal in response to an alternative range of frequencies. In the preferred embodiment, the second camera section is arranged to produce a video signal in response to light received via a second lens system 107, responsive to incident light in the infra-red spectrum, in the range of 945 to 950 nanometres. Alternatively, other IR frequencies may be employed, such as 850 nanometres upwards, although these lower wavelengths may be visible under some operating conditions.

The viewfinder 103 is of conventional design arranged to receive video signals from the first camera section 101. The viewfinder also

includes means for receiving and selectively viewing video signals from a second video source which, in this embodiment, consists of video signals received from the second camera section 102.

The output from each camera section is supplied to the remote switching device 108 arranged to selectively supply one of said video sources to a video output line 109. In addition, both of said video sources are supplied to a processing device 110 arranged to process the video signals in order to produce a composite signal on a second output line 111.

The video camera illustrated in Figure 1 is also shown in Figure 2 in which the first camera section 101, the second camera section 102 and the viewfinder 103 have been identified with similar reference numerals. The position of the camera may be adjusted manually by operation of a panning handle 201 and further adjustments to the operation of the camera, are effected by manually controllable devices 202.

Each camera section includes a lens systems 106 and 107 respectively, as shown in Figure 1. Remote manual adjustment of the first lens system also results in similar adjustments being made to the second lens system, such that the adjustments occur in unison. Thus, adjustments to the focus of the first camera system will result in similar adjustments being made to the focus of the second camera system with similar adjustments in unison occurring when the zoom angle of the lens is adjusted.

The second camera section is responsive to light generated in the infra-red spectrum and the lens system is substantially similar to that of systems used for video conferencing and similar techniques. Conventional broadcast quality lens systems are not suitable for this application, given that they are specifically configured for operation in the visible spectrum and often include coatings that attenuate non-visible lighting components. The lens system is configured to optimise its operation in response to infra-red light at 950 nanometres so as to ensure that it is possible to achieve a sharp focus at this wavelength and to optimize the video output in response to light received at this wavelength. If required, other light frequencies may be removed or suitable modifications may be made to the camera for operation at other frequencies, different from those used for conventional broadcast purposes.

The camera facilitates the processing of two or more video signals derived from substantially the same source image but responding to different light frequencies. The first video signal may be derived from the first camera section, responsive to visible light, with the second video signal being derived from the second camera section, responsive to substantially non-visible or totally invisible light. In this way, new creative effects may be generated and new program formats developed. The video signal derived from a non-visible light source may be used to enhance television pictures or to allow images to be seen by television viewers that are not visible to a studio audience nor to program participants. For example, members of the audience may be given badges or other means of identification illuminated by an infra-

red light source. This light source would not be visible to the person wearing the badge nor would it be visible to other members of the audience; but it would be visible thru cameras responsive to the non-visible light.

In an alternative configuration, visible light sources may be removed and a processing device or a switching device may select a video source from the first video camera section or a video source from the second camera section, thereby allowing television audiences to view scenes that are totally invisible to a studio audience and also totally invisible to actors or participants in television programs. Thirdly, technical modifications could be made to conventional video signals with reference to signals generated from non-visible light sources. Thus, a signal generated from a non-visible light source could be used to key parts of the video image, as an alternative to using a chromakey or other related known techniques. Most conventional video processing techniques allow picture enhancement and special effects that may be used for creative purposes to a greater or lesser extent. However, the ability to view scenes in what would normally be considered the non-visible spectrum allows completely new television program formats to be developed thereby enhancing the creative process during the production, as distinct from the post-production stage. An image derived from a scene lit in infra-red may also be used to combine images in a computer graphics environment.

In order for the second camera section to operate in response to non-visible light, it is necessary to provide suitable non-visible light sources within a studio environment.

A suitable light source of this type is illustrated in Figure 3. A housing 301 is fabricated from pre-stressed aluminium to resist impacts, as is known in the lighting art. The aluminium casing is supported by a support member 302, allowing rotation about pivots 303. The bracket 302 is supported by conventional spigot from a lighting clamp or a monopole, thus facilitating further angular adjustment.

The light includes six lighting modules 304 each containing an array of light emitting diodes arranged to emit infra-red radiation at 950 nanometres. A module 304 is detailed in Figure 4, consisting of an array of 4 x 25 light emitting diodes 401, such as device TSIP 4401 devices supplied by Telefunken. At wavelengths below approximately 900 nanometres the emitted light becomes visible to the naked eye and above 950 nanometres the second camera section becomes less sensitive and undesirable lighting effects may be created. However in some environments this may allow other special effects to be used.

The light emitting devices 401 are mounted to a heat sink 402 having a plurality of extending cooling fins 403. By using a synchronised AC source, it is possible to make more efficient use of the emitted light and reduce heat output. Consequently, with suitable adjustments being made to the electronics, it is possible to configure an array of the type shown in figure 4 without recourse to a large heat

sink. The light receives power from a toroidal transformer arranged to supply 2 amps at 24 volts from a conventional mains supply. Some of the sections 304 may be selectively switched in or out of circuit in order to allow the light intensity to be adjusted. Preferably, lighting adjustments are not made via thyristors, given that this may introduce undesirable audible background noise within the transformer, while reducing operational efficiency and increasing heat dissipation requirements. The array is covered by a protective filter that is transparent in the infra-red spectrum such as 3 mm infra-red polycarbonate sheet produced by ICI.

A studio environment is shown in Figure 5, forming part of a television production facility in which ambient light and all visible light sources may be excluded. Conventional lights 506 and 508 allow controlled illumination within the visible spectrum and television signals may be generated in response to this illumination using substantially conventional television cameras. Thus, a first camera 503 may be arranged to produce images derived from visible light sources. In addition, a second camera 509 may be arranged to produce a substantially similar image in response to infra-red light sources. Thus, within the enclosed environment of the studio, it is possible to remove all visible light sources and to illuminate scenes exclusively within the infra-red. Under these conditions, the sets are not visible to the naked eye although activities performed within the sets may be made visible to television audiences via camera 509 sensitive to infra-red light. In addition, these television signals may be relayed to monitors 510 such

that activities performed by participants, essentially in the dark, may be viewed by the studio audience.

Video signals produced in response to a single wavelength of illumination in the infra-red spectrum will produce a monochromatic image, although, under some circumstances, it is possible to colourize parts of the image to produce special effects. Measures are taken to ensure that the video signals derived from the infra-red cameras produce the highest quality images, comparable to those produced by broadcast cameras. To ensure this, scenes under observation should be lit in a professional way. Thus, in order to achieve good results, when viewing images illuminated by infra-red light, a plurality of infra-red light sources 511, of the type shown in figure 3, are arranged at appropriate locations within the studio. In a working environment, typically 20 light sources of the type shown in Figure 3 would be positioned so as to ensure that objects and participants in the foreground scene are illuminated from many angles, such that the nature of the illumination is substantially similar to the way in which foreground objects are illuminated using conventional light sources. Thus, in combination with the second camera sections, modified such that they are optimized for infra-red operation, the arrangement of the lights 511 substantially improves the quality of the resulting images thereby ensuring that the images are more than acceptable to the television audience.

An example of set 504 is illustrated in Figure 6. The set, in this example, is arranged as a conventional living room having what appear to be conventional light sources. Thus, the room includes a central light

source 601, a second light source 602 is directed at a far wall and a third light source 603 is configured as a desk lamp. In addition to light being received from a light generating device at the type shown in Figure 3, the light sources shown in Figure 6 may also be arranged to generate infra-red light, thereby illuminating the set shown in Figure 6 in the infra-red spectrum.

CLAIMS

1. Television signal generating apparatus, comprising a first camera section, a second camera section and a viewfinder arranged to receive video signals from said first camera section and from said second camera section, wherein said first camera section is configured to generate a video signal in response to incident light substantially within the human-visible spectrum and said second camera section is configured to generate a video signal from incident light substantially outside said visible spectrum.

2. Apparatus according to claim 1, wherein said first camera section and said viewfinder form part of a conventional broadcast quality camera and said second camera section is attached to said conventional camera.

3. Apparatus according to claim 1 or claim 2, wherein said second camera section is arranged to generate a video signal in response to infra-red light.

4. Apparatus according to claim 3, wherein said second camera section is responsive to light transmitted in the infra-red spectrum at 950 nanometres.

5. Apparatus according to any of claims 1 to 4, wherein said first camera section and said second camera section are operable substantially in unison.

6. Apparatus according to claim 5, wherein camera aperture, lens angle and focus of said camera sections are adjustable substantially in unison.

7. A method of processing a plurality of video signals to produce an output video signal, wherein a first video signal is derived from a camera section responsive to light having a first range of frequencies and a second video signal is derived from a camera section responsive to a second range of frequencies, wherein said second range of frequencies is different from said first range.

8. A method according to claim 7, wherein video signals are selectable in response to manual operation.

9. A method according to claim 7, wherein said second video signal is used to modify characteristics of said first video signal.

10. A method according to any of claims 7 to 9, wherein said first video signal is derived substantially from visible light and said second video signal is derived substantially from non-visible light.

11. A method according to claim 10, wherein said second video signal is derived substantially from infra-red light.

12. A television production facility, comprising means for excluding ambient light; a plurality of visible light sources for illuminating a scene with visible light; a plurality of infra-red light

sources for illuminating a scene at infra-red frequencies; a first camera arranged to produce an image of said scene in response to visible light; and a second camera arranged to produce a substantially similar image in response to infra-red light.

13. A facility according to claim 12, wherein each light source includes a plurality of light emitting devices.

14. A facility according to claim 13, wherein said light emitting devices are light emitting diodes arranged to emit infra-red light at a wavelength of between substantially 945 nanometres and substantially 950 nanometres.

15. A facility according to any of claims 12 to 14, wherein a plurality of light sources are arranged at different positions so as to illuminate images from different locations.

16. A facility according to any of claims 12 to 15, wherein said second camera is mounted on said first camera.

17. A facility according to claim 16, wherein said first camera and said second camera have a shared viewfinder.

18. Television signal generating apparatus substantially as herein described with reference to Figure 1 and Figure 2.

19. A method of processing a plurality of video signals substantially as herein described with reference to Figure 1.

20. A television production facility substantially as herein described with reference to the accompanying Figures.

The Patent Office

17

Application No:	GB 9524567.6	**Examiner:**	John Coules
Claims searched:	1-11	**Date of search:**	10 April 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): H04N 5/225,5/247,5/262,5/33

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2259211 A	(GEC-MARCONI) see whole doc	7 at least
X	GB 2191361 A	(GODWIN) see whole doc	7 at least
X	EP 0343634 A2	(FUJITSU) see whole doc	1 & 7 at least
X	WO 90/05426 A1	(PEAR-POINT) see whole doc	7 at least
X	US 5353053	(NEC) see whole doc	7 at least
X	US 5132802	(TZN) see whole doc	7 at least
X	US 5107333	(THOMSON-CSF) see whole doc	7 at least
X	Patent Abstracts of Japan, JP 06261234 A		1 and 7 at least

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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